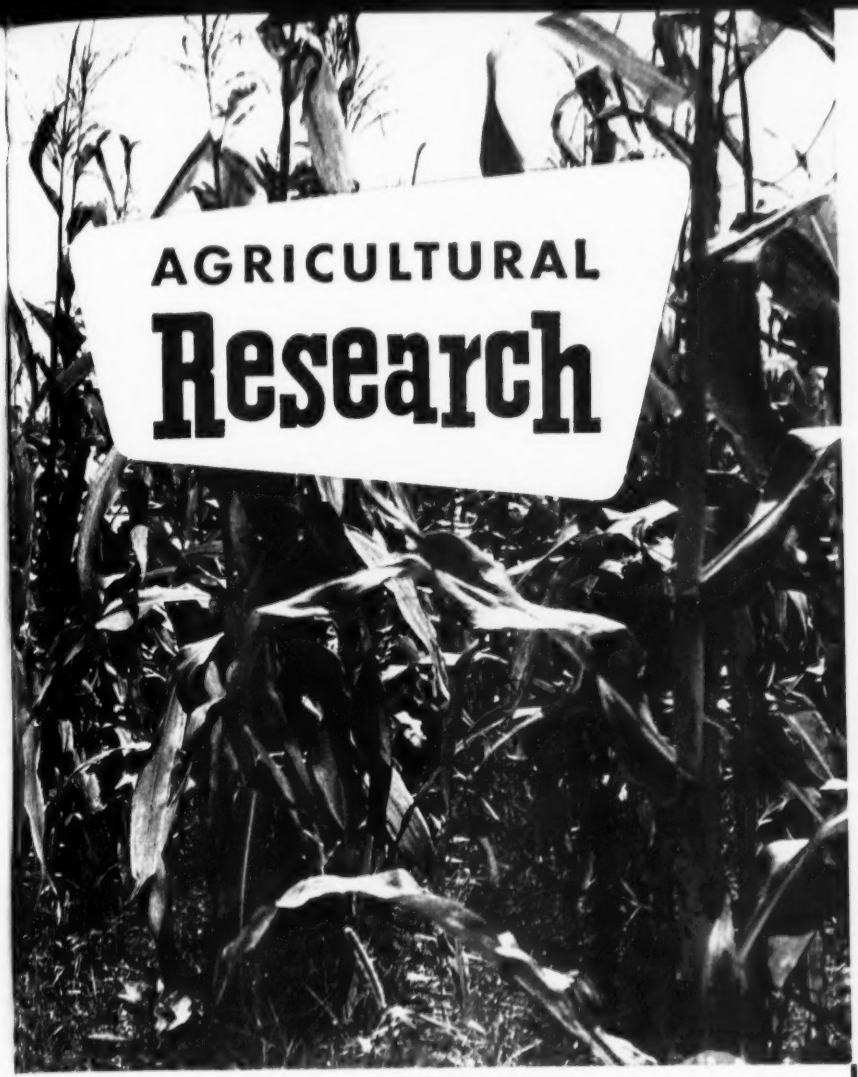
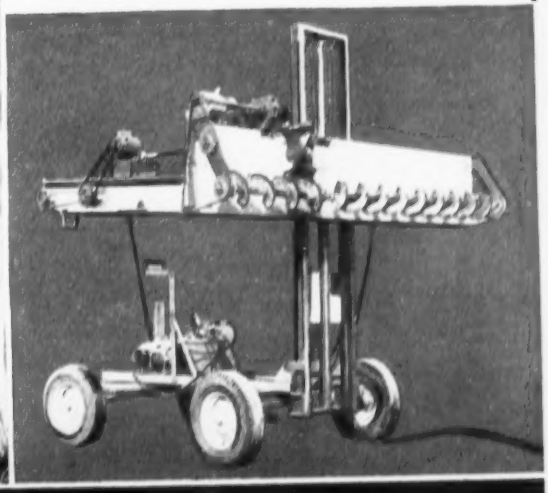


AGRICULTURAL Research

September/1960



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Contents

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Serendipity

One day in 1923, USDA scientists at Beltsville, Md., tested a culture of *Brucella abortus* taken from the milk of a cow infected with brucellosis. The strain proved virulent. Our story might have ended here had the tube not been accidentally laid aside on the desk of research veterinarian J. M. Buck and remained there for over a year at room temperature.

Instead of throwing away this old culture, Buck tested it again—and made an astonishing discovery: the bacteria had weakened, then stabilized at this low virulence. The possibilities were evident. This strain could be inoculated into calves to organize their body defenses against more virulent strains. Research eventually gave us Strain 19 vaccine, one of our most effective weapons for fighting brucellosis.

Such happy accidents have played an important part in all fields of research. Like the time a young Scottish chemist failed in his attempt to synthesize quinine—and recognized in his test tube our first coal-tar or aniline dye. Or a few decades back when a French physician noted a drop in the level of sugar in the blood of typhoid patients treated with a sulfonamide—and pointed the way to a diabetes treatment.

What about this ability to find good things that we don't set out to look for—this serendipity, as it's called? Is it luck? Yes, but it's a great deal more than that.

Viewing each of these incidents, we get a feeling that here was a man working in the highest tradition of science: curious, alert, perceptive. His mind was not confined to the thing he was looking for. He asked "What happened?" and "Why?"

There's reason to believe that we can encourage serendipity. We can broaden a scientist's total intellectual experience—basic to grasping the significance of an unusual event—by exposure to many disciplines in his training and in his day-to-day work. And we can create a favorable atmosphere for these so-called accidents by giving increased attention to imaginative basic research aimed at the discovery of new knowledge.

Serendipity is not a substitute for well-planned experiments. But it demands attention as we see diligent workers miss an answer that comes easy to one who recognizes it.

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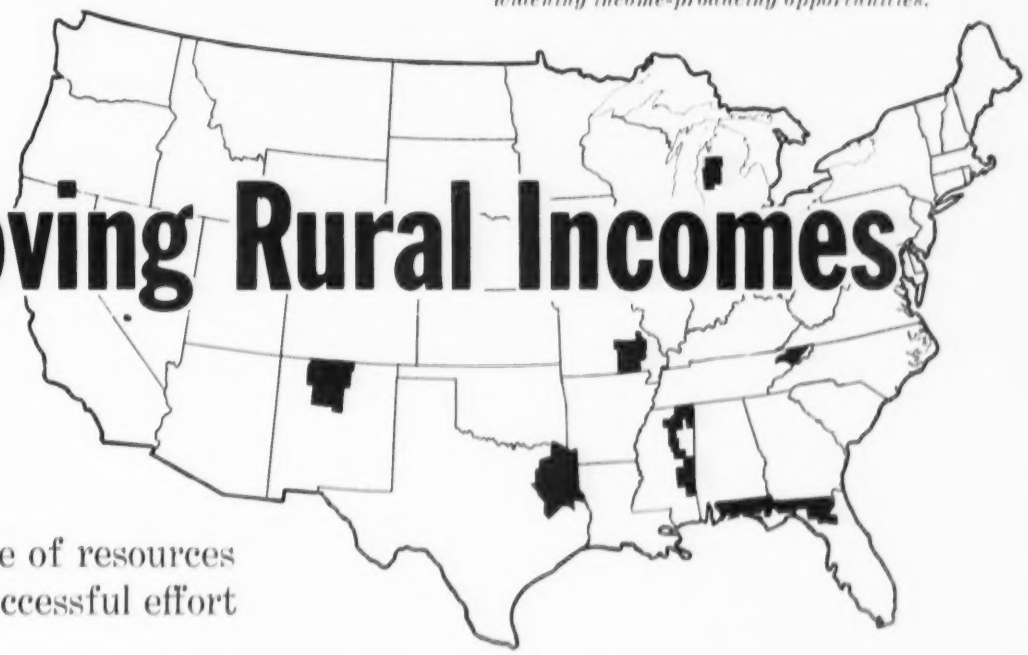
AGRICULTURAL RESEARCH SERVICE
United States Department of Agriculture

Low-producing farm areas may be helped to higher level of living through study of current production patterns and by widening income-producing opportunities.



Improving Rural Incomes

Shifting the use of resources is the key to successful effort

■ How can we relieve hardship in several depressed rural areas? By shifting use of resources within agriculture and between agriculture and other industries to boost productivity and income, say two USDA agricultural economists.

B. T. Inman and J. H. Southern suggest this after studying conditions in a representative cross section of farm and rural families in depressed areas. Those studied are in parts of Florida, New Mexico, Michigan, Mississippi, Missouri, Tennessee, and Texas.

This research makes possible recommendations that have broad application. In general, Inman and Southern suggest changes involving not only farming but nonfarm industries, employment, public and private services, and education. They also cite a need for further research to enable specific recommendations.

They've been working with other ARS and State researchers on one part of the Rural Development Program, started in 1955 to help strengthen depressed rural economies (AGR. RES., May 1959, p. 3). Cooperating are Federal, State, and local agencies.

The agricultural economists say economic development in each study zone has experienced four stages: settlement, rapid exploitation and depletion of resources by a fast-growing population, economic recession, and adjustments in use of resources. Other areas have gone through similar phases, but difficulties in adjustment in the depressed sections are more intense than usual. Adjustments were not completely successful in depressed areas, and people increasingly began seeking employment elsewhere. They have always depended on various nonfarm sources for part (up to 90 percent in some cases) of their income, so unprofitable farms are only partly the cause of hardship.

Three factors are responsible for low incomes

Largely responsible for low incomes are: (1) limitations in employment capacities of individuals; (2) lack of adequate resources to permit adoption of modern farming methods; and (3) impediments that hinder adjustments which would bring about a fuller use of resources.

About a third of the family heads in depressed areas are farm operators or farm laborers, and from about 25 to nearly 45 percent of the people are in farm families. Many are older than 45 or younger than 19, generally with little formal education and small money incomes.

About half of these families have annual net money incomes of less than $2,000—compared with 22 percent for the Nation. The proportion of commercial farm families with such low incomes is even higher, ranging up to nearly two-thirds in three areas. Except for the Michigan area, from about a fifth to a third of all families receive less than $1,000 net money income. Underemployment is more prevalent than in urban areas—considering comparable incomes for similar abilities. Popu-

Improving Rural Incomes *(Continued)*

lation decline has been more rapid than in higher income areas, and larger numbers of people—particularly youth—have left farms. Adjustments in the use of the remaining resources to maintain productivity and incomes have been very slow.

Because of the small size of farms, and lack of additional resources, government aid programs haven't contributed much to incomes. In contrast, welfare-type payments provide a considerable portion of incomes.

Changes in use of labor may help incomes

Inman and Southern suggest several ways to increase productivity and incomes in depressed rural areas. Agriculture in each is changing from intensive use of labor for row-crop production to extensive use of labor on the land—such as from cotton to livestock or timber. This change results in larger but fewer farms, but should increase production per farm and income per person. Specialty enterprises offer some opportunity for a few operators with the required skills.

Part-time farming may also increase incomes of operators who can improve efficiency and appreciably reduce costs for machinery, buildings, and marketing.

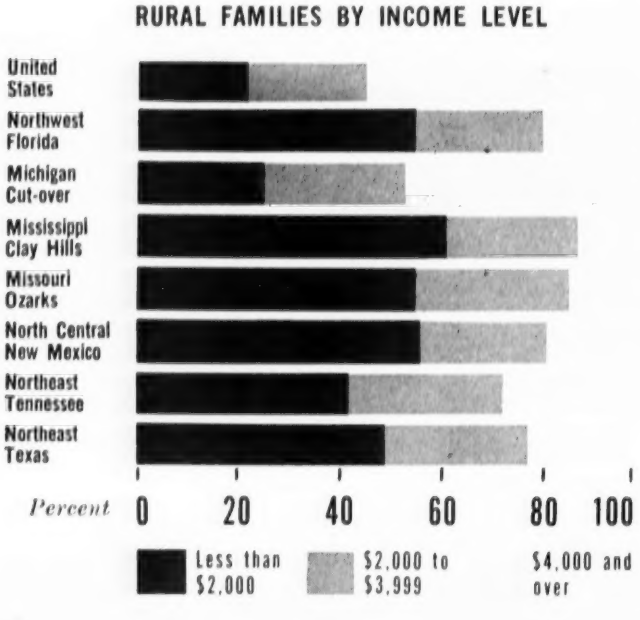
No appraisals of opportunities for industrial expansion were made. However, local officials recently have shown much interest in new industries. Some communities have acquired industries through special inducements—such as a free building and reduced taxes. This increases economic activity in an area—at least temporarily. But it may be at the expense of other areas and without adding to the national economy.

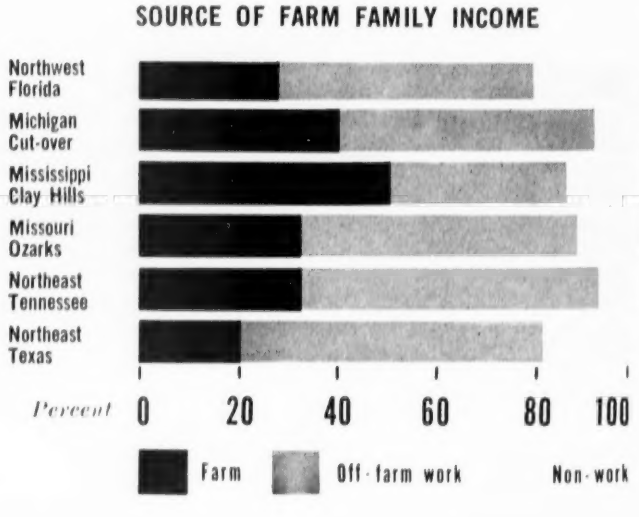
Area developers should provide adequate education and other preparation for youth. Curricula need expanding in basic subjects and vocational training. Counseling programs can help insure proper training and entrance of youth into the vocations for which they are best fitted.

Efforts are needed to increase employment of older people and those with different social and cultural characteristics. This requires selection for employment on the basis of ability to do the job. Availability of retirement payments, Social Security, and similar Federal and State benefits should help overcome the reluctance of industry to hire older persons. For people who can no longer carry a full workload, there is need for special employment to supplement their income.

Public or private services as markets, schools, churches, and highways are vital to economic growth, and maintaining them as required is important in efforts to increase incomes. In depressed rural areas, a decline in population and heavy migration of young people have obvious impacts on the services needed and provided.

Lastly, more research is needed, particularly to determine alternate systems of farming and opportunities for expanding the nonfarm sector of local economies. Other research should aim at a better understanding of welfare and social difficulties of a population heavily weighted by people of limited productive capacity because of age and other occupational handicaps. ☆

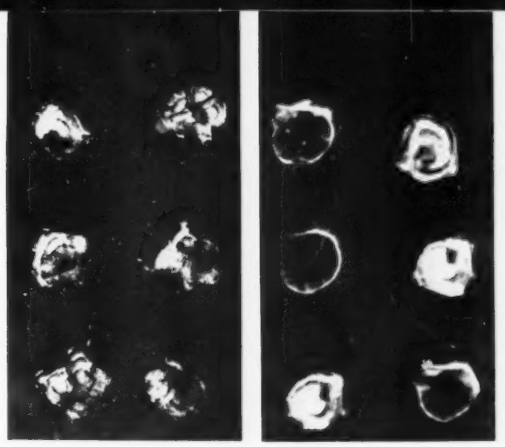




X-rays reveal seed properties of

Sugarbeets

Improved technique aids selection of widely sought monogerm varieties



Typical X-ray of sugarbeet fruits shows good single embryos, some with two or four seeds, and some with no seeds. X-rays can help select desirable single-seeded fruits.

■ Sugarbeet breeders may find a helpful tool in a technique for taking X-ray photographs of sugarbeet fruits to determine their seed properties.

This technique could help breeders select the desirable single-seeded fruits in developing the new and widely sought monogerm varieties (AGR. RES., June 1956, p. 6).

Tests by USDA agronomist G. H. Hogaboam, who is applying the X-ray technique in the cooperative sugarbeet breeding program at the Michigan Agricultural Experiment Station, East Lansing, showed that in a group of 19 breeding lines, up to 35 percent of the fruits in some lines contained no seed. Most of the samples had some fruits that contained 2 to 4 seeds in one cavity. It's apparent that monogerm strains have been inadvertently produced bearing some seedless fruit, as well as some with fruits that were multiseeded, instead of the desired single-seeded variety.

Methods previously used to examine the seed of sugarbeets involved the actual removal of the seed from its fruit. The method is time consuming and, of course, means that the seed can't be germinated intact, which is desirable for determining quality and seedling vigor.

Seed samples from 19 individually harvested monogerm sugarbeet plants were selected for study. Each sample was screened for thickness as well as diameter of fruit, since different thicknesses required different exposures to X-rays. The fruits were fastened to strips of tape mounted on templates. A low-voltage X-ray unit was used because "soft" X-rays were needed to differentiate the seed from the fruit tissue and bring out the structural details of the seed.

Exposure governs detail

The exposure selected depends upon the detail desired. Generally, the greater the exposure, the greater the detail. More research is needed to develop exact power settings for different fruit thicknesses.

Diameter of the seeds within the fruits was measured in two ways—by projecting the picture and by direct measurement. A size gauge must be X-rayed and projected to give a basis for measurement with the projection method. In addition, dark film won't project well, so a light exposure must be made and thus some detail is sacrificed. The X-ray film is mounted in a 2- x 2-inch slide, projected on a screen, and measured against a standard disc of known diameter by projecting the size gauge.

Hogaboam prefers the direct measurement method since more detail may be seen with the darker X-ray. With this method, a mirror is used to reflect light through the X-ray film. Seed diameter is measured directly with a size gauge. This was irradiated in several positions on the seed template to check on distortion, which proved to be very slight.

Here's what ARS scientist Hogaboam found in fruits of monogerm sugarbeets, using the X-ray technique:

Each sample examined had fruits that were apparently fully developed but contained aborted seeds. One sample had as few as 2 percent seedless fruits; another, 35 percent.

Sixteen of the 19 breeding lines had some fruits containing 2, 3, or 4 seeds in one cavity. Percentages of such fruits in the 16 lines varied from 0.3 to 23.8 percent.

Seed shape varied from round to oblong among samples. Twin seeds within a seedcoat were sometimes seen. Thus, Hogaboam believes that the X-ray technique might be used for locating twin embryos as a source of monoploid breeding material.

Poorly developed seeds found

The perisperm (reserve food for the seedling) of some seeds was not properly developed, although the embryo had developed normally. One seed cavity contained a fully developed perisperm but no embryo.

If labor requirements for thinning and weeding are to be reduced to the low level attainable with monogerm varieties of sugarbeets, each fruit must contain only a single seed capable of producing a vigorous seedling. The X-ray technique of Hogaboam is a tool that can be used by the breeder to reveal seed defects that arise insidiously in some unstable lines of monogerm sugarbeets. ☆

Findings may open new areas of study on interaction of viruses and nutrition

SAVING GRAPES BY STOPPING LEAFROLL

Leafroll-infected Zinfandel grapevine (right) displays stunted appearance typical of the virus disease. Healthy vine (left) contrasts sharply.

■ A lingering and damaging worldwide virus disease of grapevines should no longer injure new grape plantings, as State-USDA scientists continue to study the many varied and conflicting factors surrounding its cause and effects.

State-USDA scientists now believe that the disease of grapevines known in this country as leafroll is basically the same as the disorders known for generations in Europe as rougeau, flavescence, brunissure, red leaf, and blattroll Krankheit.

Work has shown that these disorders are not only virus caused, but their symptoms are sufficiently similar to indicate that they are caused by the same virus. Furthermore, studies also indicate that symptoms of the more seriously affected vines can be confused with potassium deficiency, causing great difficulty in distinguishing between leafroll and actual potassium starvation.

These results open new areas of study on interactions of viruses and nutrition, and may provide tools to learn how plant nutrients function or how viruses damage plants.

New criteria for fertilizer needs

And equally important, results show that freedom from virus infection must be added to established criteria for fertilizer needs—symptoms, analysis, and field response.

General signs of both leafroll and potassium deficiency include early-fall leaf coloring, rolling, burning, and necrosis of leaves, greatly reduced yields, and poor fruit quality. A visual separation of leafroll virus infection and simple potassium deficiency is almost impossible after symptoms are well advanced.

To further confuse diagnosis, leaf analyses show low potassium for both disorders; however, liberal applications of potassium will improve vine appearance and yield of plants having true potassium deficiency. For years the disease was treated as a simple potassium deficiency and was not recognized as a virus.

In recent cooperative tests at the California Agricultural Experiment Station at Davis, ARS plant pathologist A. C. Goheen and State plant physiologist J. A. Cook concluded that the leafroll virus interferes in some as yet unknown way with the movement of potassium within the grapevine, producing a deficiency in the leaf blades. Thus, the potassium deficiency is an effect, rather than a cause, of leafroll.

How, then, can you distinguish between the leafroll virus and true potassium deficiency?

Potassium content varies

The answer lies partly in knowing what to look for in *both* leaf blades and petioles (stems). For instance, leafroll reduces potassium significantly in the *blades* but increases it by more than 300 percent in the leaf

petiole. True potassium deficiency shows low potassium in both leaf blades and petioles.

Another clue to the disorder can be gained from the location of the affected leaves on the shoot. Signs of potassium deficiency develop earlier, starting with a gradual chlorosis at the edges of the midshoot leaves. Symptoms of leafroll develop later and begin with a downward rolling of basal leaves.

Leafroll symptoms reduced

Heavy applications of potassium reduce leafroll symptoms but don't prevent their development. With low potassium, leafroll accentuates potassium deficiency symptoms.

Leaves and leaf petioles of diseased and healthy vines were sampled in the field throughout the season to determine potassium differences preceding visual symptoms. Potassium was slightly higher in petioles and lower in blades of virus-infected plants until midseason. Only at harvest when leaf symptoms were already apparent could the relative potassium content be used to confirm diagnosis.

Magnesium deficiency which develops on basal leaves can be distinguished from leafroll infection by leaf *blade* analysis. Potassium is high in magnesium nutritional deficiency, while potassium and magnesium are both low in leafroll-infected blades.

Analysis shows differences

Thus, by proper analysis one can distinguish between leafroll virus disease and nutritional deficiency of either potassium or magnesium. High potassium level in the petioles will eliminate potassium deficiency; high potassium level in the blades will indicate magnesium deficiency.

Further investigations are planned on the confusing leaf symptoms of leafroll-infected and healthy vines using varying fertility levels. ☆

For chaffy grass seed:

Mechanical Analysis

■ Seed analysts soon may not have to spend long hours determining the purity of certain chaffy grass seed such as side-oats grama, Caucasian bluestem, and Indiangrass.

A mechanical method of analysis—that takes only about 20 minutes a sample—has been developed by Oklahoma and USDA scientists. It can be used on several grasses, many that are ordinarily very hard to analyze, or on mixtures. Determinations are relatively accurate even when the purity of samples varies widely.

Geneticist J. R. Harlan of the Oklahoma Agricultural Experiment Station and agronomist R. M. Ahring of ARS changed only one step of the official method to produce the new technique.

As before (1) a small representative sample of seed is weighed. Next (2) the various types of seed in this sample are separated and identified, and the amount of each is determined. Now, instead of (3) examining each floret for the presence or absence of a grain (or caryopsis), all seed of the kind under consideration in the sample is processed at once with a rubbing board, screen, and blower.

This removes coverings and exposes the seed. (Very little seed is lost or damaged, and only small amounts of trash are left.) The number of grass seeds present is multiplied by a conversion factor—a number calculated by Harlan and Ahring for each of several grasses—to give a purity percentage which can be applied to each lot of seed. Finally (4) the pure grass seed is planted to determine the percent of germination.

In recommending adoption of the new technique, the researchers say it is repeatable—even for high- and low-purity seed that is difficult to analyze. In addition, the new method doesn't require the services of a highly trained analyst. The net result is lower analysis costs.

Use of the current method requires from about 3 up to 12 hours for each sample, depending on the kind of seed. Steps one, two, and four take only a few minutes to perform. But step three may require hours of exacting work. It's necessary to determine the presence of each seed by pinching the covering with forceps, pressing with a needle or spatula, or observing individual seeds over a diaphanoscope.

When seed analysts must work under pressure, as they frequently do, errors can result in step three, especially since it's easy to confuse some tiny plant parts for equally small seeds or to miss counting long, slender, and soft seeds that are often hard to detect.

Time and expense for the current official method are frequently out of proportion to the value of the crops analyzed, Harlan and Ahring point out. (This is particularly true for wild native grasses, which are so trashy that it's virtually impossible to perform an accurate analysis of the seed.)

Unavoidable frequent delays in obtaining analyses are highly detrimental to the production, orderly marketing, and utilization of important chaffy grass seed, they conclude. ☆

Field plants are individually sprayed with solution of spores of Helminthosporium *species.*

WHAT'S AHEAD IN CORN RESEARCH

Efforts turn to genetics, physiology, and diseases

Corn borer inflicts heavy damage on susceptible plant (left) but makes pinholes only on resistant plant (right), because larvae die shortly after they begin feeding.

■ Development of hybrid corn was an enormous advance in corn breeding, giving us more vigorous plants, with uniformly high yields, because we had more precise control over genetic inheritance. Now, nearly 96 percent of the corn planted is hybrid. What's next in corn research?

USDA and State efforts are turning more and more to basic studies in genetics, physiology, and diseases of corn. Such studies are aimed at obtaining new knowledge that will increase our ability to develop and modify plants—through control of inheritance and nutrition—to fill specific market needs and to resist disease. Here are some of the studies which seem to offer more immediate possibilities for practical application.

In cooperative research at the Missouri Agricultural Experiment Station, an ARS geneticist is working with haploids, genetically rare plants which may be useful in obtaining purer lines of corn, and in less time than generations of inbreeding takes. Cells of haploids contain only one set of chromosomes (bodies which carry the heredity-bearing genes). Doubling the chromosome number, which may happen naturally or by use of chemicals, would produce plants with the two sets of chromosomes normally found in corn, but the two sets would be identical. Haploids occur in corn in low frequency, but stock has been found in which an unusually high number occurs.

Most important of all, this characteristic has been shown to be transmissible, in crosses with the high-frequency stock as male parent, to other corn lines. Thus it may be possible to produce lines of corn that are absolutely true breeding. Present procedures would require 20 to 30 generations of inbreeding to produce plants considered to be 99.99 percent true breeding.

Basic research on the action and interaction of genes to produce hereditary effects is continuing with the "converter" gene which changes its partner into a replica of itself (AGR. RES., July 1959, p. 3).

A study of the mutation rate of quantitative traits (characteristics such as yield, height, etc., which are controlled by many rather than single pairs of genes) has been made jointly by ARS and the Iowa Agricultural Experiment Station, Ames. (A full report on this study will appear in a later issue.)

A differing ability to absorb from the soil or to make efficient use of magnesium has been found in different lines of corn in cooperative research with the Ohio Agricultural Experiment Station at Wooster. Attempts are being made to determine the genetic basis for this difference and whether it is related to absorption or to the plant's use of magnesium once it has been absorbed.

Much information on the distribution pattern of different elements in corn plants has been accumulated through use of radioactive isotopes.

Protein synthesis, Enzyme systems to be studied

Other research in physiology is conducted jointly with the University of Illinois, Urbana, where the interest is in protein synthesis. The germ in corn kernels contains balanced protein—protein made up of all the amino acids essential for nutrition of humans and animals. But protein of the endosperm, the major portion of the corn

Magnesium deficiency shows as yellowish-white streaks in leaf.

Haploid plant (center) is much smaller than normal plants (diploids) on either side of it.

kernel, is deficient in two essential acids—lysine and tryptophane. Total protein content varies in different lines of corn, but as content increases, percentage of unbalanced protein increases. To find out what happens when proteins are synthesized, physiologists are beginning study of enzyme systems. Enzymes (which are proteins themselves) are the chemical architects of other proteins and plant compounds.

An ARS plant pathologist in Raleigh, N.C., is cooperating with the State in basic studies on the life cycles of fungi attacking corn and other grain crops. He has developed techniques to produce in the laboratory the sexual stage of *Helminthosporium* species which cause leaf diseases of corn, rice, wheat, oats, barley, and many grasses. A fundamental aim is to learn the full genetic potential of these organisms so that we may be better able to combat them. Attempts are also being made to learn more about specific host-parasite relationships. Hybrid species of *Helminthosporium* have been produced by crossing a corn-attacking species with a rice-attacking species. The hybrids segregated into strains which attack corn only, rice only, corn and rice, and neither.

In experiments conducted by ARS and Purdue University, a substance which inhibits *H. carbonum* in culture has been isolated from corn plants resistant to the fungus. The substance has not been identified.

At the Agricultural Research Center, Beltsville, Md., research is in progress on the mode of inheritance of resistance to two other *Helminthosporium* species, *H. turcicum* (northern leaf blight) and *H. maydis* (southern leaf blight). Studies thus far have resulted in release of fifteen resistant inbred lines. Resistant inbreds have also been released cooperatively with Purdue. Resistance of a double-cross hybrid increases directly as the number of resistant inbred lines in its parentage are increased. Field procedures have been developed to inoculate plants, and studies are continuing on the genetic basis for different degrees of resistance.

Team of scientists work on corn borer resistance

Also at Beltsville, studies are underway on the host range and requirements for infection of three related species causing leaf rusts of corn.

The life cycle of the fungus causing brownspot of corn, a disease which can cause losses in the South, is being investigated by ARS and the Mississippi station.

Research on the European corn borer by an agronomist-entomologist-chemist team includes efforts to determine the chemical basis for resistance. The scientists have developed a technique to grow larvae on artificial media and have isolated a substance from corn that retards growth of larvae in culture. These studies are being made cooperatively by ARS and the Iowa Agricultural Experiment Station, and are partially supported by a grant from the Rockefeller Foundation.

Besides the specific studies mentioned here, research in progress in other areas is adding to our fund of basic information in plant science, and bringing knowledge that may be widely applied and that may serve as a basis for new approaches in corn research. ☆

Following much work on how water supply affects yields of pastures and hay crops, scientists now study

How Moisture Affects Root Growth

Root depth differs at various moisture levels, established by irrigating when 30, 65, and 80 percent available soil moisture was removed.

■ Improved water-use efficiency and a better environment for plant growth may come out of USDA irrigation studies in Alabama. ARS researchers showed how soil moisture levels affect the roots of eight cool weather forage species.

In general, rooting depth decreased as soil moisture increased and total root weight decreased as soil depth increased. Tested were Kenland red, California ladino, and intermediate white clovers, Atlantic and African alfalfas, orchardgrass, tall fescue, and reed canarygrass.

The effect of soil moisture levels on pastures and hay crops has been widely studied. Forage yields are generally higher and plants more succulent when there's plenty of moisture. But costs of irrigating pastures and forage crops are usually high because of their long growing seasons. To make it pay, farmers must know all the factors involved.

Irrigation schedules, for instance, are affected by rooting behavior of crops as well as by other important factors. The depth of the plant root system limits the area from which moisture can be extracted.

In the most recent studies, ARS soil scientists O. L. Bennett and B. D. Doss determined exactly how soil moisture levels affect root behavior, to set proper wetting depths for irrigation. The work was done in cooperation with the Alabama Agricultural Experiment Station.

Three moisture levels were established by irrigating when 30, 65, and 80 percent of the available soil moisture had been removed in the rooting zone of the plants. Rooting depths—from 24 to 36 inches—were estimated on the basis of the average lowest soil moisture content for each depth after excessive dry periods.

There were differences in rooting depths among species. But the effective rooting depth was influenced more by the soil moisture content maintained than by forage species.

Moisture used first from top soil, then lower depths

After each irrigation, the plants removed moisture first from the top 6 inches of soil where root concentration was highest. As soil moisture tension increased near the surface, more moisture was extracted at successively lower depths. Plants usually wilted before much of the available moisture was used at lower depths. This indicates that concentration of roots at lower rooting depths wasn't great enough for plants to extract moisture fast enough to keep up normal transpiration.

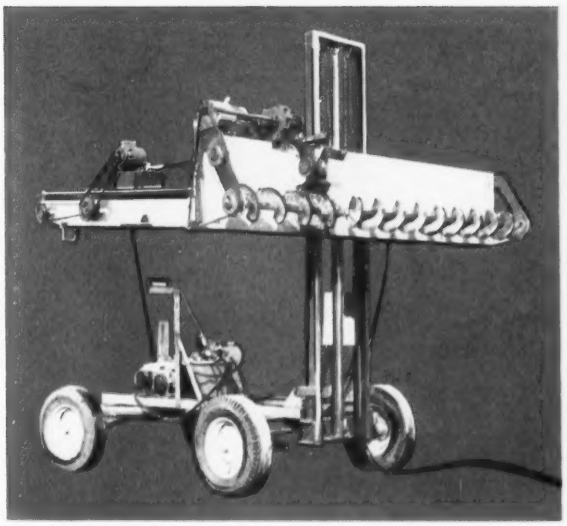
Over 75 percent of the total weight of the roots was found in the top 12 inches for all species at all moisture levels. Some species had more than 50 percent of the total root weight in the top 3 inches.

Reed canary and tall fescue grass had the most profuse rooting systems, although Atlantic alfalfa produced a greater root *weight*. Alfalfa roots were larger in diameter, thus accounting for the greater root weight. Total root weight was greatest—on all plants except African alfalfa and red clover—at low soil moisture levels. For these two species, the largest root weights were at the high moisture levels.

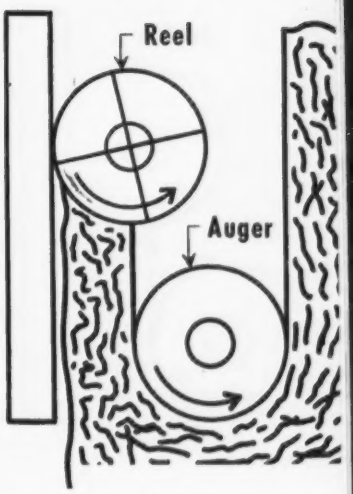
Orchardgrass had the smallest amount of roots at all soil moisture levels. The roots extended only to 26 inches at the high levels and to 48 inches at the low levels. Root patterns were characterized by taking 3-inch core samples, soil profile samples, and soil moisture extraction patterns. ☆

Coming: AUTOMATIC UNLOADER FOR HORIZONTAL SILOS

This auger-type device is expected to handle up to 200 pounds a minute



Auger cuts 16 inches thick, 10 feet wide, 12 feet deep (top to bottom) in about 50 minutes—and removes about 6,400 pounds.



Reel, not shown in photo, moves fallen silage into auger, allows deeper cut.

■ A new horizontal-silo unloader shows promise as a way to save much time and labor by feeding animals *automatically*, according to USDA agricultural engineers.

When further improved, this electrically powered, auger-type device is expected to automatically unload, convey, and distribute 175 to 200 pounds of corn, short grass, or other silages per minute. In tests at Puyallup, Wash., the machine (operating semiautomatically) successfully handled corn and oat-pea silage. Labor and time required were no more than for operating an unloader for an upright silo.

With a blower and pipe for conveying in initial tests, the device unloaded oat-pea silage (sometimes difficult to handle) at the rate of only 40 pounds a minute. But the unloader handled more than 125 pounds of corn silage per minute when the blower and pipe were replaced with a more efficient 12-foot aluminum conveyor, and other modifications were made. Although the machine wouldn't handle long grass (it wound around the auger), researchers believe an effective cutting system can be developed for removing this type of silage.

Undercarriage adapted from rubber-tired wagon

D. R. Vilander, until recently an ARS agricultural engineer, developed the unloader in cooperation with the Washington Agricultural Experiment Stations.

Essentially, the device consists of a 12-foot hydraulic lift mounted on an undercarriage adapted from a rubber-tired farm wagon. On the lift mechanism is a frame holding an auger 9 inches in diameter. The auger motor and speed-reducing unit are also attached to the frame, along with the conveyor (it's at right angles to the auger). The motor for the conveyor is mounted above it. The hydraulic system is on the undercarriage.

Auger removes more than 3 tons in single cut

The auger, which has mower knives attached, removes silage by making a cut 16 inches thick, 10 feet wide, and 12 feet deep from top to bottom of a silo. (Such a cut takes about 50 minutes and yields about 6,400 pounds of silage—enough to feed 80 cattle 80 pounds each.) Limit switches at top and bottom automatically reverse the vertical motion.

Silage is augered from each side to the conveyor as the mechanism descends. Then the silage enters the conveyor, which is free to move up and down as the auger moves. The conveyor carries silage to a truck or wagon, or can supply a second conveying system going directly to feeders for completely automatic operation.

Researchers have yet to develop a means of eliminating the need for a man to advance the unloader after each cut and to start and stop the machinery. A major difficulty is that a small amount of silage falls to the ground as the auger cuts. The silage piles up and keeps the auger from making a complete cut to the base of the silo. This difficulty has been partly taken care of by adjusting the auger to take a thicker cut and adding a reel to help guide the silage into the auger. ☆

Research Drawings By Machine

Simplicity of new drawing machine is apparent. Medical biology technologist John Blair slides the microscope along on glass pane, outlining specimen below.

■ A simply designed drawing machine constructed to meet the needs of scientists at the USDA Regional Poultry Research Laboratory, East Lansing, Mich., is producing some really first-rate life-size drawings.

Designed and constructed by ARS anatomist A. M. Lucas, the true-scale device gets rid of all distortion and produces drawings of perfect proportions. Drawings can be magnified up to three times.

Basically, the instrument includes a low-powered, single-lens microscope, an adjustable pantograph, and a glass-topped specimen table that can be raised or lowered. Lucas uses a small hand-operated hydraulic pump for this operation, but a small electric motor could be installed.

The microscope rides on a steel plate which is connected with the pantograph by a ball-bearing ring. Any movement of the microscope causes a corresponding movement of the pantograph, poised with an attached pencil over the drawing paper.

Operator's job is mechanical

The operator focuses the crosshairs in the microscope on an edge of the specimen. He slides the microscope along on the pane of glass, following the outlines of the specimen below, always keeping the crosshairs exactly above the edges of structures to be drawn. The pantograph, of course, reproduces on a large scale the movement of the microscope. Since the operator's job is completely mechanical, the drawing is perfect and leaves no room for operator misinterpretation. Additional details may later be sketched in by hand.

The need for some type of really accurate drawing device became apparent to Lucas in the preparation of his reference book on avian anatomy. Many hundreds of original detailed drawings were necessary to cover the most minute phases of anatomical structure. And while careful free-hand drawings were adequate, they were subject to the interpretation and artistic ability of the artist, inevitably causing a slight amount of distortion. The machine can be operated quickly and accurately. The operator needs little or no training and no artistic ability whatever. ☆

WEATHER AND KETOSIS IN DAIRY CATTLE

■ Temperature extremes may be more important than other environmental factors—including diet—as a cause of ketone formation in blood of dairy cattle.

This may explain why ketosis, a metabolic disorder caused by an excess of ketones in the blood, is more prevalent among dairy cows in some years than in others. Ketones are intermediary compounds formed when fats or some amino acids are broken down for energy.

Ketosis is known in practically every country where dairy farming is practiced, and often affects high-producing cows. A million cases are reported in the U.S. in some years. The disorder is seldom fatal, but it frequently lowers vitality and reduces milk production.

Experiments by ARS chemist P. J. Van Soest at USDA's Agricultural Research Center, Beltsville, Md., showed that when the temperature dropped to 3° F. during the winter, ketones in the blood of test cows were four to six times the normal .002 to .006 percent. At 100° F., the amount of ketones present was about double normal.

Two or three days passed before a change in air temperature caused a change in ketone level. Why either high or low temperatures affected ketone levels in the blood is not known.

Tests were made over an 18-month period of a summer season and two winters. Six dairy cows with no history of ketosis were used. Increases in ketones induced in test animals by extreme temperatures masked attempts to study variation as influenced in individual cows by lactation, season, environmental conditions, and physiological status. Despite the high levels of blood ketones developed during tests, no symptoms of ketosis were noted, indicating that some animals may be resistant. ☆

TREES RESTORE STRIP-MINED LAND

Forests can provide salable crop, effective watershed management, and recreational areas

■ Lands strip-mined for coal are ugly and unproductive but can be made useful and beautiful by planting to trees, USDA foresters find.

Special methods are necessary to establish desirable vegetation because conditions of mine-spoil banks are unlike most natural planting sites. Guides for tree planting on mine banks, based on results of experimental planting of different species under a wide variety of bank conditions, have been developed by the Central States Forest Experiment Station at Columbus, Ohio. The research was done in nine midwestern States—Arkansas, Illinois, Indiana, Iowa, Kansas, Kentucky, Missouri, Ohio, and Oklahoma. In these States nearly 200,000 acres had been stripped for coal in 1947 and the stripping has continued. Many mining companies have reclaimed the stripped lands, however, by careful planting and the application of Forest Service research findings.

Select proper tree species

The key to restoration, the foresters found, is to determine the characteristics of the bank and then select a tree species and planting method suitable for those characteristics. All important factors influencing tree growth—proportion of stone to soil, kind of stone, soil texture, structure of the bank, pH value, nutrient availability, topography, method of mining, grading, and tendency to erode—should be considered.

The specific effect of any one factor usually cannot be isolated from the combined influence of all. Sometimes the effect of one may supplement that of another, and sometimes both may be counteracted by a third. For example, high acidity, rapid erosion, or bank topography, could each preclude the choice of certain species on otherwise suitable sites.

A species that grows naturally in the area should be selected—one that is not highly susceptible to prevailing insects and diseases. Researchers found bank conditions were suitable for 23 different tree species, including both hardwoods and softwoods.

Planting young trees is a surer way to get a forest started on strip-mined banks than seeding. Natural seeding may result in filling the banks with trees of little commercial value. Sowing seeds directly on the banks may give the same result.

Extra benefits from trees

Tree planting combines several benefits that some other methods of reclaiming banks do not have. Trees will produce a salable crop—Christmas trees, posts, pulpwood, or sawtimber. Also, tree species stabilize slopes and are an effective watershed management tool. And finally, forested land makes good parks and wildlife habitats, which in turn help to fill the ever-increasing demand for outdoor recreational facilities. Many good camping, fishing, and picnic grounds have been established along watercourses formed by impounding water. ☆

Wise tree selection and planting can erase scars like this one from the landscapes of coal mining districts.

Tree planting has changed this former strip-mining area from an eyesore to a useful, attractive recreation area.

Industry-provided preparation services result in labor, time, and space savings

WE'RE BUYING MORE PROCESSING WITH OUR FOOD

■ The marketing system has taken over more and more of the tasks involved in preparing food for the table—to the point where nearly all of the food purchased today has been processed to some extent.

This observation came from an analysis of expenditures for food used by manufacturing plants with 250 or more persons on their payrolls. Food economist Rosalind C. Lifquist of USDA's Agricultural Marketing Service, in determining the amounts spent for foods at various stages of preparation, included as processing any service that reduced the work needed to prepare it for the table.

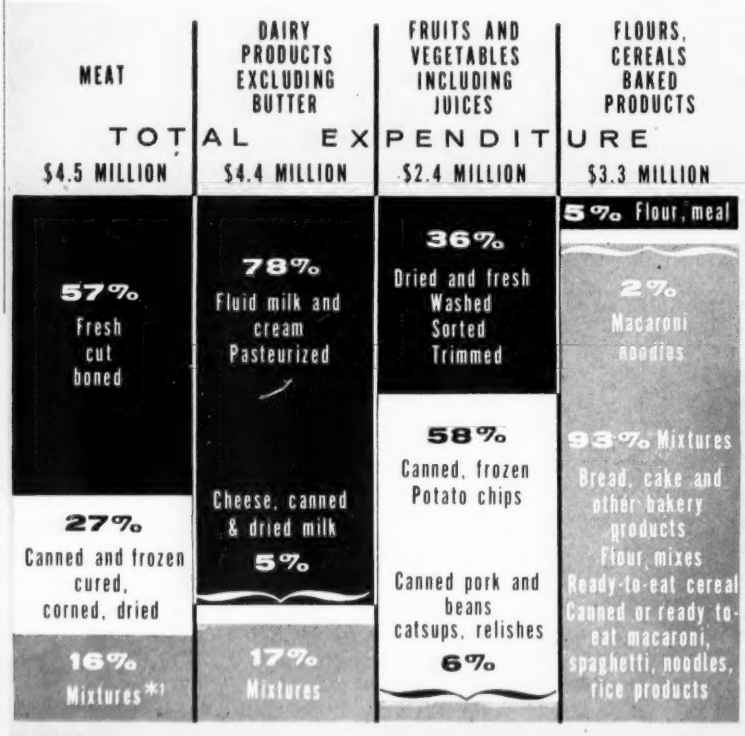
The study was undertaken because of growing interest in food preparation services provided by processors and wholesalers and to get more information on markets provided by away-from-home eating places. Farmers are interested because, in general, their share of the food dollar declines as foods are more highly processed. Marketing firms are concerned with how well their services are accepted and who buys them. Consumers are interested in the kinds and cost of services available.

Managers of factory cafeterias consider that services provided by wholesalers and processors save labor costs, time, and space, and insure a uniform product. With less waste, purchasers have better control of amount and quality of food they buy.

Of the $20 million spent for food by the cafeterias during the 4-week study, half went for products that required little or no further preparation for the table. In this group are dairy and bakery products, and fruits and vegetables that required only washing, trimming, peeling, or cutting up. Items that had only to be heated before serving, such as canned foods, took about 10 percent of the expenditures. Forty percent was spent for food that had to be cooked and required close timing, complicated recipes, or long cooking. Meat, poultry, and fish represented half the expenditures in this group.

Small plants tended to purchase more marketing services than large ones. Small plants spent proportionately more of their food dollar for products such as processed cheese, canned fruits and vegetables, bakery products, and sugar, for foods purchased from mobile canteens, and less for fresh meats, vegetables, and fruit. ☆

PURCHASES OF FOODS BY INDUSTRIAL CAFETERIAS AT DIFFERENT STAGES OF PROCESSING BY MARKETING AGENCIES



EXPENDITURES ACCORDING TO AMOUNT OF PROCESSING DONE BY MARKETING AGENCIES

*1 *Canned, frozen, fresh luncheon meats.*

*2 *Such as butter, cheese, macaroni, noodles, hydrogenated fats.*

New fungus identified

A fungus new to the United States has been identified as the cause of cylindrosporium leaf spot of sesame by a USDA plant pathologist cooperating with the Florida Agricultural Experiment Station, Gainesville.

No attacks of the disease, only recently observed in the United States, have been reported in Texas, the State in which most of the sesame is produced commercially, according to the ARS researcher, R. G. Orellana. The fungus isn't considered serious and there are resistant sesame strains.

Cylindrosporium leaf spot first appeared in the United States at the Florida station in 1958 and was later found in South Carolina.

To identify the parasite, investigators compared infected leaves with Nigerian herbarium samples of the fungus *Cylindrosporium sesami* Hansford and found the two fungi to be identical. Nigeria and Uganda are the only other countries in which the Hansford species has been observed.

C. sesami is closely related to fungi which attack plums and cherries and causes symptoms similar to those of cercospora leaf spot, a banana disease. Uganda's Department of Agriculture first differentiated cylindrosporium from cercospora leaf spot in 1861 and gave its present name to the disease-causing organism.

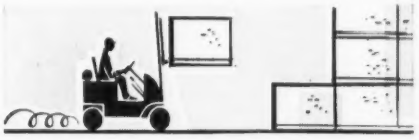
Better potato handling

Pallet boxes can be more efficiently filled with Irish potatoes at the warehouse or storage center rather than in the field right from the mechanical harvester, according to USDA scientists. Field filling will not reduce the cost of using pallet boxes for harvesting and storage.

Many growers of Irish potatoes use pallet boxes for storage, which is costlier than bulk storage but advantageous for fast and easy handling of processing potatoes. Most of these growers fill the boxes at the warehouse or storage site (growers call the practice yard filling). But others fill the boxes directly from the harvester in the field, believing that the high cost of box handling and storage can be reduced.

USDA agricultural engineers and horticulturists at the Red River Valley Potato Research Center, East Grand Forks, Minn., analyzed labor and equipment costs and injury to the potatoes in comparing field and yard filling. Here's what they found:

The same number of workers are needed for harvesting, field filling, and placing pallet boxes in storage as are required for harvesting, yard filling, and placing boxes in storage. Field filling reduces by one the number of workers required at the warehouse. But this saving is cancelled by the requirement of an additional worker in the field.



Furthermore, the receiving rate at the warehouse is not increased by the field filling. Six 1-ton pallet boxes can be filled from a bulk truck and placed in storage in less time than is required to remove six filled boxes from a flat-bed truck, place them in storage, and put six empty ones back on the truck.

Detailed analyses of equipment costs showed no advantages in field filling. Cost of equipment needed at the warehouse is reduced only slightly, while the substantial cost for special equipment on the harvester would result in a greater total cost for equipment.

Personnel requirements are the same for both methods. But labor costs for field filling operations may be higher due to a reduced harvesting rate. Since yard filling can be accomplished with as little as 0.2 percent grade defects, there is little margin—and from a practical viewpoint no possibility—for reduction of injury to potatoes.

Food patterns similar

When a homemaker is employed outside her home, the family tends to spend slightly more money for food, but her employment has little effect on the nutritive value of the diet, according to food economists in the ARS Institute of Home Economics.

About one-fourth of the homemakers interviewed in the USDA Nationwide Food Consumption Survey (AGR. RES., Jan. 1957, p. 8) were employed and carried on homemaking duties as well. The researchers analyzed the women's replies to see if employed homemakers followed food patterns different from those of nonemployed homemakers.

They found that consumption of meat, poultry, and fish was greater in households with employed homemakers. They bought bakery products rather than baking at home. But they used less milk than nonemployed urban homemakers—probably because fewer had children under 16.

Households with employed homemakers on the average eat out oftener—not only lunches but family meals—probably as a time- or energy-saving practice. Households with nonemployed homemakers at higher income levels were an exception—they

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spent as much or more for meals out as those with employed homemakers.

In general, more diets provided by employed homemakers were short in thiamine and riboflavin than those by nonemployed women, but the differences were slight. The inadequate diets did not include sufficient milk or enough enriched, restored, or whole-grain products.

Insects take much stress

Insects can tolerate the stress of thousands of times normal gravity (g) with rapid acceleration or deceleration, USDA entomologists find.

This characteristic, together with their ruggedness and less stringent environmental requirements, makes them suitable for gaining biological information from space where more sensitive organisms might perish.

Earlier tests (AGR. RES., Feb. 1959, p. 7) had shown that fruit flies survived and reproduced under stress of 10 g's. Now researchers W. N. Sullivan and T. R. McCauley find that 50 percent of confused flour beetles sur-

vived when subjected to 20,600 g's for 73 minutes. Other insects tested did not stand as much stress—houseflies had 50 percent survival under 11,400 g's for 2 minutes and Japanese beetles the same rate of survival under 6,250 g's. Man is reported to be injured after a short exposure of 18 to 45 g's.

The insects were placed in tubes in a refrigerated centrifuge equipped to produce high speeds. The tubes reached maximum speed in 90 seconds and decelerated in approximately 3 minutes. After the test the insects were placed in a container with food. The insects that died during centrifuging and during a short period after (for flies the period was 1 day, for beetles 10 days) were considered to have died from the test. Most of the deaths occurred during centrifuging. Survivors were apparently normal in appearance and behavior.

Studies are continuing on the ability of insects to withstand other stresses, such as high vacuum, which would be encountered in space flights.

Three new pear varieties

Small amounts of budwood of Magness and Moonglow, new pears for central and eastern States, and of Dawn for western States, have been released by USDA for increase by nurserymen.

Trees of the new varieties, not now available for general distribution, will probably be available from nurserymen in 1962. Because these pears have not been tested regionally, ARS scientists suggest only limited plantings until performance is evaluated in each growing area.

Magness and Moonglow are highly resistant to pear blight and so are suitable for planting in the East and Midwest where it has been impossible to grow other high-quality pears. Dawn is only slightly resistant to blight and should be planted in areas where the disease is not serious.

Magness fruit is high in quality, sweet flavored, juicy, and highly aromatic. Oval shaped, the fruit has strong, russet-colored skin somewhat

resistant to insect punctures and decay. The flesh is softer than that of Bartlett pears and is practically free of grit cells. A good dessert pear, it matures about 1 week after Bartlett and ripens in about 10 days when stored at 70° F.

Magness trees are vigorous and spreading. They produce a good blossom set but no pollen, so other pears are needed nearby to insure pollination. Parent trees and propagations from them have thorns, but this characteristic may decrease or disappear as repropagations are made.

Fruit of Moonglow and Dawn closely resembles Bartlett in shape and other respects but matures about 2 weeks earlier. Both are of good quality, aromatic, slightly acid, and smoothskinned. Moonglow pears are larger than those of Dawn, ripen 15 to 18 days after picking, are moderately juicy, quite free of grit cells, and well suited to canning or fresh uses. Dawn pears are small, juicy, spicyflavored, good for canning, and ripen 12 to 14 days after harvest.

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